

**Claims:**

**Claim 1. (Currently Amended)** An end host comprising:

a memory including:

executable instructions;

storage for respective identifiers for respective peers of the end host

in a peer-to-peer system, wherein the storage comprises:

a multilevel routing table cache (MRTC),

each level in the MRTC includes a maximum number of

entries,

each level in the MRTC represents a segment of a number space corresponding to an identifier of the end host,

the top level of the MRTC spans the entire number space,

each successively lower level comprises successively smaller

spans,

each [[said]]span in a level below the top level is a smaller segment than the entire number space,

each [[said]]span is clustered around one [[said]]identifier of a corresponding [[said]]peer, and

the relative proximity between the peers corresponds to the respective identifiers[[,]];

an array for each [[said]]peer of the end host, wherein:

each [[said]]array includes a neighbor hint table (NHT);

each [[said]]array includes one or more entries; and

each [[said]]entry corresponds to one neighbor peer of one

peer of the end host (NPOP); and

includes an identifier for the NPOP, wherein each

[[said]]identifier for the NPOP comprises:

an IP address of the respective [[said]]NPOP;

a port number of the respective [[said]]NPOP; and

an ID generated from a public key of the respective

[[said]]NPOP, wherein relative proximity between the NPOP's

is a function of the proximity of the respective identifiers of

the peers;

a processor for executing the executable instructions which, when executed, cause the processor to interact with the end host as a peer in a peer-to-peer fashion in the peer-to-peer system, the interacting comprising:

when a message is sent from the end host to a destination[[, said]] peer having an identifier not found in the MRTC, forming a message for [[a]]the destination peer for which the identifier thereof is not found in the

MRTC, wherein the message includes the identifier of the destination peer; and

addressing the message to an intermediate [[said]]peer for which the identifier thereof is in the memory and where the intermediate [[said]]peer has an address which is proximally closest to the identifier of the destination [[said]]peer;

wherein the executable instruction further comprise an architecture that includes:

logic for a kernel layer, wherein the logic for the kernel layer comprises:

an internet protocol (IP) layer comprising an end-to-end mobility module for end communications between the end host and another end host in the [[peer to peer]]peer-to-peer system; and a transport layer on the IP layer for communications across interconnected networks of the peer-to-peer systems; and

logic for an application layer on the kernel layer and wherein the logic for the application layer comprises:

a name resolution module for resolving [[said]]identifier for a respective [[said]]peer in the peer-to-peer system to IP address, and storing the

identifier of the respective [[said]]peers of the end host in the storage; and

a notification module of the name resolution module for storing the identifier for each [[said]]NPOP in each [[said]]entry in each [[said]]array.

**Claim 4. (Currently Amended)** The end host as defined in Claim 1, wherein the proximally closest identifier of the intermediate [[said]]peer is found in a portion of the memory selected from the group consisting of:

one [[said]]entry in one [[said]]array; and  
the MRTC.

**Claim 5. (Currently Amended)** The end host as defined in Claim 1, wherein a message is delivered to [[a]]the destination [[said]]peer from the end

host by transmission via a number of [[said]]peers, wherein the number of [[said]]peers being no more *than O(log k N)* on average over time;

k is a factor by which [[t-he]]the spans of each [[said]]successively lower level is successively smaller; and

N is a number of [[said]]identifiers in an identifier naming space for the MRTC.

**Claim 6. (Currently Amended)** The end host as defined in Claim 1, wherein the interaction of the end host as a peer in peer-to-peer fashion in the peer-to-peer system comprises forming a message for delivery to [[a]]the destination [[said]]peer via one or more neighbor peers of [[said]]the destination [[said]]peer.

**Claim 7. (Currently Amended)** The end host as defined in Claim 1, wherein the interaction of the end host as a peer in peer-to-peer fashion in the peer-to-peer system comprises addressing a message for transmission to each [[said]]NPOP of the peer to which the end host is unable to communicate for further transmission to the peer to which the end host is unable to communicate.

**Claim 8. (Allowed)** The end host as defined in Claim 7, wherein the message includes a new IP address of the end host when the IP address of the end host changes.

**Claim 9. (Currently Amended)** The end host as defined in Claim 1, wherein the interaction of the end host as a peer in peer-to-peer fashion in the peer-to-peer system comprises registering one [[said]]identifier for the end host with each of the respective peers of the end host in the peer-to-peer system.

**Claim 10. (Currently Amended)** The end host as defined in Claim 1, wherein the interaction of the end host as a peer in peer-to-peer fashion in the peer-to-peer system comprises:

- establishing a communication connection between the end host and one [[said]]peer of the end host;
- losing the established communication connection for a predetermined time threshold;
- receiving a message from the one [[said]]peer of the end host wherein the message includes a new IP address of the one [[said]]peer; and
- resuming, using the new IP address, the communication connection between the end host and one [[said]]peer of the end host.

**Claim 11. (Currently Amended)** The end host as defined in Claim 10, wherein the message is received via one [[said]]NPOP.

**Claim 12. (Allowed)** The end host as defined in Claim 1, wherein relative proximity between the peers in the peer-to-peer system is a function of the proximity of the respective identifiers of the peers.

**Claim 13. (Currently Amended)** The end host as defined in Claim 1,

wherein:

each [[said]]identifier of each [[said]]peer is a numerical expression; and  
relative proximity between the peers in the peer-to-peer system  
corresponds to numerical proximity of the respective identifiers of the peers.

**Claim 15. (Currently Amended)** The end host as defined in Claim 1,

wherein each [[said]]identifier of each [[said]]peer comprises:

an IP address of the peer; and  
an ID generated from a public key of the peer, wherein relative proximity  
between the peer and other [[said]]peers in the peer-to-peer system is a  
function of the proximity of the respective identifiers of the peers.

**Claim 16. (Currently Amended)** The end host as defined in Claim 1,

wherein the entries in each [[said]]array are ordered according to a priority of  
the NPOP selected from the group consisting of:

available bandwidth of the NPOP;  
proximity of the NPOP to the corresponding [[said]]peer of the end host;  
degree of trust between the NPOP and the corresponding [[said]]peer of  
the end host;  
probability that the IP address of the NPOP will change; and

a combination of the foregoing.

**Claim 18. (Allowed)** The end host as defined in Claim 1, wherein the transport layer on the IP layer is a TCP/UDP layer.

**Claim 19. (Currently Amended)** The end host as defined in Claim 1, wherein each [[said]]peer in the peer-to-peer system is selected from the group consisting of:

- a cellular telephone;
- a computing device having a wired connection to the [[peer to peer]] peer-to-peer system; and
- a computing device having a wireless connection to the [[peer to peer]] peer-to-peer system.

**Claim 20. (Allowed)** The end host as defined in Claim 1, wherein the interaction of the end host as a peer in peer-to-peer fashion in the peer-to-peer system comprises:

- receiving updates to the identifier for the NPOP for each entry in each array; and
- sending an updated IP address for the end host to each peer of the end host.

**Claim 21. (Currently Amended)** A [[peer to peer]]peer-to-peer system comprising first and second means for interacting as respective peers in a peer-to-peer fashion in a peer-to-peer system, wherein each [[said]]first and second means respectively comprises:

    a processing means for interacting in the peer-to-peer system;

    one or more close peers in the peer-to-peer system, wherein each [[said]]close peer includes one or more neighbor peers (NP);

    means for storing one identifier in memory for each of the one or more close peers,

        wherein the means for storing one identifier for each of the one or more close peers comprises a multilevel routing table cache (MRTC),

        wherein each level in the MRTC includes a maximum number of entries,

        wherein each level in the MRTC represents a segment of a number space corresponding to an identifier of the respective first and second means,

        wherein the top level of the MRTC spans the entire number space, wherein each successively lower level includes successively smaller spans,

wherein each [[said]]span in a level below the top level is a smaller segment than the entire number space,

wherein each [[said]]span is clustered around one [[said]]identifier of a corresponding [[said]]close peer, and

wherein the relative proximity between the close peers corresponds to the respective identifiers;

means for storing an array for each [[said]]close peer, wherein:

each [[said]]array includes a neighbor hint table (NHT);

each [[said]]array includes one or more entries; and

each [[said]]entry:

corresponds to one [[said]]NP; and

includes an identifier for the NP;

includes an identifier for the NP, wherein each [[said]]identifier for the NP[[OP]] comprises:

an IP address of the respective [[said]]NP;

a port number of the respective [[said]]NP; and

an ID generated from a public key of the respective [[said]]NP, wherein relative proximity between the NPs is a function of the proximity of the respective identifiers of the peers;

wherein the first means is a close peer to the second means;

when the IP address of the first means changes and there is a break in an ongoing communication between the first and second means for longer than a predetermined time threshold, each of the first and second means further comprises:

means for addressing a message for transmission to each NP of each close peer of the other of the first and second means for delivery of the message thereto via each NP, wherein the message includes the changed IP address thereof; and

means for:

receiving the message via the NP;

extracting the changed IP address of the other of the first and second means from the message; and

resuming the ongoing communication using the changed IP address of the other of the first and second means[[.]];

wherein the communication between the first and second means further comprise an architecture that includes:

logic for a kernel layer wherein the logic for the kernel layer comprises:

an internet protocol (IP) layer comprising an end-to-end mobility module for end communications between the end host and another end host in the [[peer to peer]]peer-to-peer system; and

a transport layer on the IP layer for communications across interconnected networks of the peer-to-peer system; and logic for an application layer on the kernel layer and wherein the logic for the application layer comprises:

- a name resolution module for resolving [[said]]identifier for a respective [[said]]peer in the peer-to-peer system to IP address, and storing the identifier of the respective [[said]]peer[[s]] of the end host in the storage; and
- a notification module of the name resolution module for storing the identifier for each [[said]]NP[[OP]] in each [[said]]entry in each [[said]]array.

**Claim 23. (Currently Amended)** The peer-to-peer system as defined in Claim 21, wherein, when the IP address of either of the first and second means changes, [[said]]either of the first and second means respectively further comprises:

- means for addressing a message for transmission to each [[said]]NP when communication cannot be made, after a predetermined threshold, to the corresponding [[said]]close peer, wherein the message includes the changed IP address; and

means for:

receiving the message;  
extracting the changed IP address from the message; and  
communicating with the corresponding [[said]]close peer using the  
changed IP address.

**Claim 25. (Allowed)** The peer-to-peer system as defined in Claim 21,  
wherein each of the first and second means further comprises:

means for registering an identifier thereof with each of the close peers;  
and  
means for receiving an identifier for each of the NP of each of the close  
peers.

**Claim 27. (Currently Amended)** The peer-to-peer system as defined in  
Claim 21, wherein for the first means, when a message is sent to a peer in the  
[[peer to peer]]peer-to-peer system having an identifier not found in the MRTC  
of the first means, the first means further comprises:

means for forming a message for [[a]]the destination [[said]]peer for  
which the identifier thereof is not found in the memory, wherein the message  
includes the identifier of the destination [[said]]peer; and

means for addressing the message to an intermediate [[said]]peer for which the identifier thereof is in the memory of the intermediate [[said]]peer, and is the proximally closest to the identifier of the destination [[said]]peer.

**Claim 28. (Currently Amended)** The peer-to-peer system as defined in Claim 21, wherein the proximally closest [[said]]identifier of the intermediate [[said]]peer is found in a portion of the memory selected from the group consist of:

one [[said]]entry in one [[said]]array; and

the MRTC.

**Claim 29. (Currently Amended)** The peer-to-peer system as defined in Claim 21, wherein:

the message is delivered to the destination [[said]]peer from the first means by transmission via a number of [[said]]peers, wherein the number of [[said]]peers being no more than  $O(\log k N)$  in average;

$k$  is a factor by which the spans of each [[said]]successively lower level is successively smaller; and

$N$  is a number of identifiers in an identifier naming space for the MRTC.

**Claim 30. (Currently Amended)** The peer-to-peer system as defined in Claim 21, wherein each [[said]]peer is selected from the group consisting of:

- a cellular telephone; a computing device having a wired connection to the [[peer to peer]]peer-to-peer system; and
- a computing device having a wireless connection to the [[peer to peer]]peer-to-peer system.